

# OPERATIONAL ACCEPTANCE TEST PLAN for the AWIPS MPLS WAN

August 2006

U.S. DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
National Weather Service/Office of Operational Systems  
Field Systems Operations Center/Test and Evaluation Branch



Version 3.2 August 18, 2006

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## Acronyms

AWIPS	Advanced Weather Interactive Processing System
CE	Customer Edge
CRH	NWS Central Region Headquarters
FMK	Field Modification Kit
FR	Frame Relay
FSOC	Field Systems Operations Center
HIC	Hydrologist-In-Charge
IT	Information Technology
ITSO	Information Technology Security Office
LF	Lead Forecaster
MHS	NCF Message Handling System
MIC	Meteorologist-In-Charge
MNS	Sprint Managed Network Services
MPLS	Multi-Protocol Label Switching
NCEP	National Centers for Environmental Prediction
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
NWSTG	NWS Telecommunication Gateway
OAT	Operational Acceptance Test
OCIO	Office of the Chief Information Officer
OPS24	Office of Operating Systems, Test and Evaluation Branch
OST	Office of Science and Technology
OST31	Office of Science and Technology, Analysis Branch
PAMS	Product Availability Monitoring System
PE	Provider Edge
POC	Point-of-Contact
PVC	Permanent Virtual Circuits
RFC	River Forecast Center
RTMS	AWIPS Real Time Monitoring System
SEC	System Engineering Center
SLA	Service Level Agreement
SOP	Standard Operating Procedures
TOC	Telecommunication Operations Center
TRG	Test Review Group
TTR	Test Trouble Report
VRF	Virtual Routing and Forwarding
VPN	Virtual Private Network
WAN	Wide Area Network
WFO	Weather Forecast Office
WSH	National Weather Service Headquarters

## **Executive Summary**

This plan describes Government tests conducted during the Operational Acceptance Test (OAT) of the Advanced Weather Interactive Processing System (AWIPS) Multi-Protocol Label Switching (MPLS) Wide Area Network (WAN), herein referred to as the MPLS OAT.

An MPLS Pilot study is being completed by Raytheon under contract DG133W-05-CQ-1067 to evaluate the use of an MPLS WAN for AWIPS network communications and to develop strategies for migrating AWIPS network communications to an MPLS WAN. The MPLS OAT will be conducted in parallel with the Pilot study.

The MPLS OAT will be completed with oversight of a Test Review Group. The Test Review Group reviews OAT activities, coordinates issues, classifies any problems identified during the OAT, and works to resolve any problems discovered. Upon the completion of field tests, the Test Review Group recommends whether to proceed with national deployment of the MPLS WAN for AWIPS communications.

# Operational Acceptance Test Plan for the AWIPS MPLS WAN

## 1 Introduction

This plan describes Government tests conducted during the Operational Acceptance Test (OAT) of the Advanced Weather Interactive Processing System (AWIPS) Multi-Protocol Label Switching (MPLS) Wide Area Network (WAN), herein referred to as the MPLS OAT.

Statement of Need 05-056, *IT Consolidation—Network Infrastructure* and Concept of Operations and Operational Requirements, *IT Management and Infrastructure Consolidation—Network Infrastructure*, Version 1, October 16, 2005, propose the migration of all National Weather Service (NWS) network communications to an MPLS WAN. Under this proposal, the existing Frame Relay (FR) WAN currently employed for AWIPS network communications would be superseded by the use of an MPLS WAN. The transition to the MPLS WAN will be implemented in two phases: an initial MPLS Pilot demonstration followed by the migration of all AWIPS sites within the continental United States to an MPLS WAN. The MPLS Pilot is being completed by Raytheon under contract DG133W-05-CQ-1067 to evaluate system requirements and strategies for the migration of AWIPS network communications. The MPLS OAT will be conducted in parallel to the MPLS Pilot.

### 1.1 Test Plan Organization

This OAT Plan is comprised of four sections:

Section 1 contains introductory materials describing the purpose of the test, the testing strategy, the test objectives, and the prerequisites for the OAT.

Section 2 contains background information on NWS network communications.

Section 3 discusses the management of the OAT including the roles and responsibilities of the personnel participating in the OAT.

Section 4 describes the process and procedures employed during the OAT including the test schedule and test related activities performed at National Weather Service Headquarters (WSH) and the OAT sites. The conditions for a recommendation for national deployment of the MPLS WAN and preparation of an OAT Report are also discussed.

### 1.2 Purpose

This MPLS OAT is undertaken to validate the procedures for installation of MPLS network hardware and transitioning AWIPS network communications to an MPLS WAN, to verify that documentation and other technical support services are adequate for use of an MPLS WAN for AWIPS network communications, and to evaluate the performance of an MPLS WAN during actual AWIPS operations.

### 1.3 Testing Strategy

An MPLS WAN will be deployed for AWIPS network communications at a limited number of sites in the NWS Central Region. The sites selected for the MPLS OAT include two Weather Forecast Offices (WFOs), two River Forecast Centers (RFCs), NWS Central Regional Headquarters (CRH), and the AWIPS

Table 1: Sites selected for the MPLS OAT.

Site ID	Node Type	Location	Role
Nodes on the MPLS Pilot Network:			
ABR	WFO	Aberdeen, SD	primary WFO site
FGF	WFO	Grand Forks, ND	primary WFO site
BCQ	CRH	Kansas City, MO	NWS Central Regional Headquarters
KRF	RFC	Pleasant Hill, MO	primary hub for ABR and BCQ
MSR	RFC	Chanhassen, MN	primary hub for FGF
NCF	NCF	Silver Spring, MD	AWIPS Network Control Facility
Alternate RFC nodes: (Frame Relay Network)			
TIR	RFC	Wilmington, OH	alternate hub for FGF
TUA	RFC	Tulsa, OK	alternate hub for ABR and BCQ
Control nodes: (Frame Relay Network)			
PBZ	WFO	Pittsburgh, PA	control WFO site
LZK	WFO	Little Rock, AR	control WFO site

Network Control Facility (NCF), which is located in Silver Spring, MD. The sites selected for the MPLS OAT are listed in Table 1. The RFCs TIR and TUA, which are located in Wilmington, OH and Tulsa, OK respectively, are communications nodes in the existing FR WAN. The WFO sites PBZ and LZK are included in the OAT as control sites.

The NWS Test and Evaluation Branch (OPS24) will collect network performance data using the Product Availability Monitoring System (PAMS). Network communications will initially be monitored to establish the baseline performance of the existing FR WAN: The FR WAN will be monitored for a period of approximately 30 days starting on or about July 5, 2006. Baseline monitoring will continue until the MPLS WAN is deployed on or about August 21, 2006.

The MPLS OAT will begin by assessing the installation of the network hardware at each site: The MPLS Provider Edge (PE) routers will be installed by Sprint, the network service provider. Site personnel will install a Customer Edge (CE) router, a NetScout T1 Probe, NetScout T1 Tap Kit, and required cables interconnecting AWIPS and the MPLS WAN routers. NCF will remotely configure the AWIPS communications network to define the MPLS WAN as the preferred path for network communications. The existing FR circuits will remain in place throughout the MPLS OAT, and network communications may be rolled back to the FR WAN in the event of failure or unacceptable performance of the MPLS WAN. Once the MPLS WAN has been installed and tested, sites will conduct normal operations using the MPLS WAN for the remainder of the OAT. Standard Operating Procedure (SOP) will be followed using the MPLS WAN as the primary network for AWIPS communications and ADTRAN as the backup system. Site and NCF personnel will report any problems discovered during the installation and/or operation of the system. Network communications will be monitored using PAMS to establish the performance of the MPLS WAN starting on or about August 21, 2006 and ending on or about October 6, 2006.

Two control WFO sites, PBZ and LZK, are included in the OAT to monitor ongoing AWIPS network communications over the FR WAN. These data may indicate whether the measured performance of the MPLS WAN is due to the behavior of the MPLS network or to other factors. All activities associated with this OAT will be transparent to the service operations of the two control sites as well as the RFCs TIR and TUA.



## 1.4 Test Objectives

The specific objectives of the MPLS OAT follow:

- Validate the instructions for installation of hardware for the MPLS WAN.
- Validate the Field Modification Kits (FMKs).
- Verify that support services provided by NCF and the network service provider are adequate for AWIPS communications.
- Verify that the use of an MPLS WAN does not degrade AWIPS WAN communications.

## 1.5 Evaluation Criteria

The evaluation criteria to be used for the MPLS OAT follow:

- The AWIPS System Modification Notes (Mod Notes) for installation of hardware must provide accurate and complete instructions.
- The FMKs must contain all required cables and associated hardware for installation of the MPLS WAN.
- Test Trouble Reports (TTRs) assigned Impact 1 or 2 must be closed, and any work arounds must be fully documented.
- All measures of network communications performance for the MPLS WAN must equal or exceed those obtained for the existing FR WAN, and the measured network communications performance must be consistent with the Sprint Service Level Agreement (SLA).

## 1.6 Prerequisites, Assumptions, and Risks

### 1.6.1 MPLS OAT Prerequisites

The prerequisites for the MPLS OAT follow:

- **System documentation:** Two separate Mod Notes are required: The first Mod Note contains installation instructions for the MPLS WAN hardware. The second Mod Note contains instructions for making the cable connections between AWIPS routers 1 and 2 and the CE router.
- **OAT documentation:** An approved OAT Plan.
- **Hardware:** The FMKs include the MPLS WAN CE router, which is a Juniper SSG 550 router, NetScout T1 Probe, NetScout T1 Probe Kit, cables, and other associated hardware.
- **Software:** NCF software modifications required to define the MPLS WAN as the primary channel for AWIPS network communications and to support remote switching between the FR WAN and the MPLS WAN.

### 1.6.2 Assumptions

It is assumed no special training is required for installation, operational use, and maintenance of the MPLS WAN.

### 1.6.3 Risks

The use of MPLS WAN services for AWIPS operations cannot be tested in a simulated environment and must be tested at active field sites. The tests described herein may require certain novel and unproven procedures; hence there is some risk of a loss or degradation of network communications during the MPLS OAT. Reliable broadband network services are required for AWIPS operations; and network communications will be monitored throughout the OAT. The existing FR WAN circuits will be kept in place throughout the OAT; and AWIPS communications may be returned to the FR WAN should network performance fall below acceptable levels or in the event of an MPLS network outage.

The following general guidelines have been established in consultation with various stakeholders in the MPLS OAT, i.e., NWS Central Headquarters, Office of Operational Systems (OOS), Office of the Chief Information Officer (OCIO), Office of Science and Technology (OST), AWIPS Network Control Facility (NCF), and Raytheon.

#### **General Guidelines for the Conduct of the MPLS OAT and Pilot:**

- AWIPS NCF Standard Operating Procedure (SOP) will be followed whenever possible.
- AWIPS NCF will continue in its current role as the control center for AWIPS communications. Sites will continue to receive 24×7 support from the NCF during the MPLS Pilot; and the NCF will continue to have the authority to make key decisions regarding network configuration and communications in a timely manner.
- The operational requirements of the sites have precedence over the MPLS Pilot. Sites may request that FR network services be restored at anytime, if continued operation using normal backup systems, i.e. ADTRAN, or the MPLS WAN may jeopardize the full delivery of products and services by the site.
- The MPLS OAT and Pilot will be conducted in a manner to reduce the risk of a degradation of network services or to pose undue risk to field operations.

## 2 Background

The NWS WAN is currently procured, managed, and operated on a distributed basis. A small backbone network interconnects the WSH and the respective NWS Regional Headquarters, i.e., NWSNet. While the Telecommunication Operations Center (TOC) leads configuration and procurement activities, the individual headquarters operate, perform diagnostics, and respond to user issues on their own or in concert with the TOC when appropriate. Similarly, the Regions procure, operate, and manage independent regional networks. The National Centers likewise, procure, operate, and manage an independent network tailored to meet the unique requirements of the mission of the National Centers for Environmental Prediction (NCEP) in addition to providing Information Technology (IT) services common across the NWS. Major programs, such as AWIPS, procure, operate, and manage the “operational” network infrastructure, once again independent from other IT infrastructure elements. The National Oceanic and Atmospheric Administration (NOAA) Line Offices also independently procure, operate, and manage their own IT infrastructure.

Extensive cost and feature analysis have been conducted to evaluate candidate technologies for NOAA network infrastructure. All indications, including the trouble-free transition to the NWSNet backbone during FY05, are that a carrier-provided MPLS network that is isolated from the Internet, is most advantageous for the NWS. Further design work in conjunction with the Backup NWS Telecommunication Gateway’s (NWSTG’s) Critical Infrastructure Protection project has been based on a networked solution, specifically MPLS. The NOAA Enterprise Target Architecture (ENTA) business case has also arrived at this technology

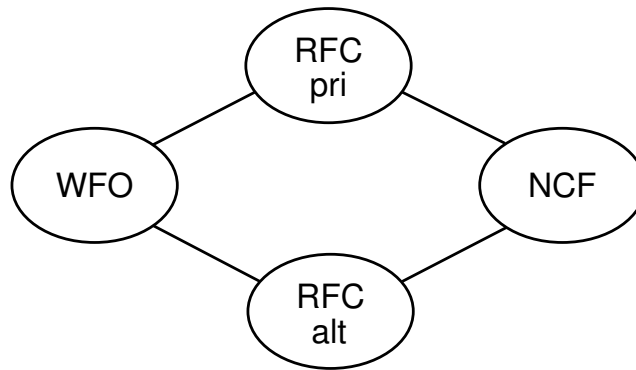


Figure 1: Frame Relay point-to-point network architecture. The FR WAN provides a primary (pri) route to the NCF and a redundant alternative (alt) route.

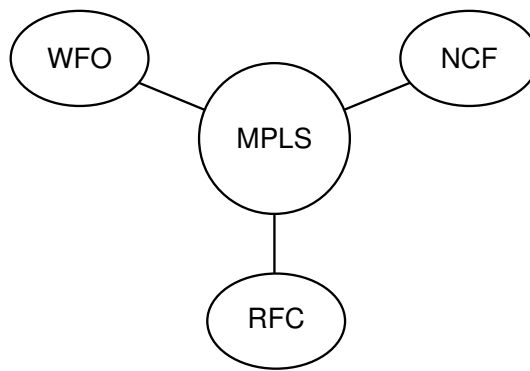


Figure 2: MPLS any-to-any network architecture. Each AWIPS site will connect to the MPLS WAN.

for consolidating NOAA IT infrastructure, for which NWSNet is considered by the NOAA OCIO to be the NOAA Net pilot.

## 2.1 AWIPS WAN

The AWIPS network communications are currently provided by a FR WAN. The FR WAN has a hub and spoke architecture: Each WFO is connected to two RFCs and the RFCs are connected to the NCF. The flow of information between the WFOs and the NCF is relayed through the RFC hubs. The FR WAN provides a primary RFC for each WFO and a redundant route to the NCF through an alternative RFC. A highly simplified block diagram of the exiting FR WAN is shown in Figure 1.

The proposed MPLS WAN architecture is shown in Figure 2. As shown, each AWIPS network site is connected to the MPLS WAN. The proposed MPLS WAN will be configured to provide a Virtual Private Network (VPN) to support the needs of NOAA network communications. The VPN will isolate NOAA communications from Internet traffic and will support the existing FR connectivity, that is, the flow of information between the WFOs, RFC, and the NCF will be retained in the MPLS VPN.

## 2.2 Network Monitoring Tools

Network communications will be monitored using PAMS, the AWIPS Real Time Monitoring System (RTMS), and NetScout probes.

### 2.2.1 Product Availability Monitoring System

PAMS was developed by OPS24 to measure the performance of network communications and has been used in numerous OATs and demonstration projects to evaluate proposed changes in network communications. PAMS monitors end-to-end network communications at the Internet Protocol (IP) layer: Each message sent over the AWIPS network is entered into a message log on both the sending and receiving servers. The log entries contain a time stamp, message identifier, and World Meteorological Organization (WMO) message header information that may be used to uniquely identify each message. The message time stamp is referenced to the AWIPS clock, which is synchronized across the network to within a stated uncertainty of  $\pm 1$  sec.

PAMS relies on an off-line analysis of the server message logs. The server logs are pushed from the site servers onto a server located in WSH. The logs are then pushed or pulled onto a local machine for analysis. The header information and time stamp for each log entry may be queried to provide diagnostic information regarding network communications. These methods place very little additional burden on network communications and are thus relatively noninvasive.

The figures-of-merit considered for the OAT are the message delay,  $\Delta t$ , and the network message loss,  $L_m$ . The message loss, expressed in percent, is given by the following equation,

$$L_m = \frac{n_s - n_r}{n_s} 100,$$

where  $n_s$  is the number of messages sent and  $n_r$  is the number messages received in a given time interval. The message delay is given by the following equation,

$$\Delta t_i = t_{ri} - t_{si},$$

where  $t_{si}$  is the time that message  $i$  was sent and  $t_{ri}$  is the time the message was received. The time averaged delay is given by

$$\overline{\Delta t_i} = \frac{1}{n_r} \sum_i \Delta t_i,$$

where  $n_r$  is the number of messages received in the time interval.

OPS24 will monitor the end-to-end communications between the WFO sites and the NCF using PAMS. The hourly and daily average message delays and message loss rates will be calculated. OPS24 will provide a daily report of network performance to Raytheon. These same data will be analyzed by OPS24 and reported to the Test Review Group (TRG).

### 2.2.2 Real Time Monitoring System

The AWIPS RTMS is maintained under contract with Raytheon. The system sends periodic test messages over the AWIPS communications network and monitors the message delay times. The system monitors end-to-end network communications at the IP layer. The system is similar to PAMS in design, in that message diagnostics are derived from the server message logs, however it provides measurements of system performance in real time. The MPLS OAT sites will be monitored during the OAT and OPS24 has requested access to these data.

### 2.2.3 NetScout Probe

NetScout T1 Probes will be installed at each of the MPLS OAT sites. The Probes monitor network traffic at each of the CE routers and are connected to a central server for analysis. OCIO maintains a contract for these network diagnostics services. OPS24 has requested access to these data.

## 3 Test Management

A description of the major roles and responsibilities of test personnel follows.

### 3.1 Test Review Group

The MPLS OAT will be conducted under the oversight of the MPLS Test Review Group (TRG). The TRG is comprised of subject-matter experts selected from WSH, NWS Regional Headquarters, RFCs, and WFOs. The members of the TRG are listed in Attachment D.

Field tests of the MPLS WAN at operational NWS field service sites must be authorized by the TRG; and field tests may be suspended by the TRG at anytime, should the performance of the MPLS WAN be found unacceptable. If field tests are suspended, the TRG will authorize the resumption of tests when appropriate corrective actions have been taken. The TRG may recommend that additional diagnostic tests be completed prior to the resumption of field tests.

The TRG meets periodically during the conduct of field tests. Meetings of the TRG are convened to review, clarify, and validate deficiencies documented by Test Trouble Reports (TTRs). The TRG will evaluate each TTR and assign an Impact and Priority according to the criteria provided in Section 4.6.2. The TRG works to resolve deficiencies and other test-related issues, and may recommend corrective actions to the MPLS AWIPS Point-of-Contact (POC). The regularly scheduled meetings of the TRG are listed in Table 3. The TRG may also meet irregularly or on an emergency basis, as needed. Teleconference access will be provided to the meetings of the TRG. Meetings of the TRG are coordinated by the OAT Director.

Following the completion of field tests, the TRG will convene to review the findings of the test and to recommend whether to proceed with national deployment of the MPLS WAN.

The decisions of the TRG are based on consensus among the voting members listed in Attachment D.

### 3.2 Test Review Group Chair

The TRG is chaired by the Chief, Test and Evaluation Branch, or his designated representative. The Chair works to ensure that tests are conducted efficiently and to resolve any issues that may arise during the conduct of the OAT.

The Test Review Group Chair is a voting member of the TRG.

### 3.3 MPLS AWIPS POC

The MPLS AWIPS POC ensures that all required hardware, software, and documentation are available for the OAT. The AWIPS POC participates in the meetings of the TRG and other informal meetings as required, reviews problems documented and classified during the OAT, and coordinates the adjudication of problems. The MPLS AWIPS POC also reviews the OAT Plan and the OAT Report.

The MPLS AWIPS POC is a voting member of the TRG.

### 3.4 OCIO Focal Point

The OCIO Focal Point plans and coordinates OAT activities with OCIO staff members. OCIO staff will test each MPLS circuit for a period of approximately 72 hours to ensure that the lines are clean; monitor network traffic using the NetScout T1 Probes throughout the OAT; and interact with Sprint regarding network services. The OCIO Focal Point participates in the meetings of the TRG and reviews plans and reports during the OAT.

The OCIO Focal Point is a voting member of the TRG.

### 3.5 OAT Director

The OAT Director ensures that tests are performed as described in the OAT Plan. The OAT Director coordinates the meetings of the TRG, collects and presents TTRs to the TRG for classification, and ensures that all TTRs documented and classified during the OAT are forwarded to the proper WSH organization for resolution.

The OAT Director prepares and distributes weekly status reports summarizing TTRs, operational issues, and completed tests. Following the completion of field tests, the OAT director briefs the TRG on the status of the tests conducted, summarizes the TTRs submitted, and reports any other test related issues. The OAT Director ensures that the results of the OAT are properly documented in an OAT Report.

The OAT Director is a non-voting member of the TRG.

### 3.6 Test Team

The Test Team is comprised of subject-matter experts selected from WSH. Members of the Test Team perform test support duties as assigned; assist test sites in completing TTRs when problems are observed; and provide technical advice to the OAT Director.

Test Team members are non-voting members of the TRG.

### 3.7 Regional Focal Points

NWS Regional Focal Points provide liaison between the WFOs and WSH. The Regional Focal Points participate in meetings of the TRG, review plans and interim reports during the OAT, coordinate issues, classify problems identified during the OAT, and work to resolve problems discovered during the OAT.

The NWS Regional Focal Points are voting members of the TRG.

### 3.8 Site Focal Points

Site Focal Points plan and coordinate OAT activities with their respective NWS Regional Focal Points, plan and coordinate the installation of the MPLS WAN hardware, participate in meetings of the TRG, review plans and reports during the OAT, complete and submit TTRs for all problems discovered during the OAT, and complete and submit the MPLS OAT Questionnaire, Attachment B, to the OAT Director following the conclusion of field tests.

The Site Focal Points are non-voting members of the TRG.

### 3.9 Lead Forecaster

The Lead Forecaster is the primary point-of-contact for issues affecting site operations: NCF will contact the Lead Forecaster in the event of a network outage or any change in network configuration that may impact site operations.

Lead Forecasters may participate in the meetings of the TRG.

### 3.10 MPLS NCF POC

The configuration of the AWIPS communications network must be carefully monitored throughout the OAT. The MPLS NCF POC will coordinate the migration of AWIPS communications to the MPLS WAN with NCF staff and will work to resolve any network problems discovered during the OAT.

The NCF POCs are non-voting members of the TRG.

## 4 Test Conduct

The site Meteorologist-in-Charge (MIC) or Hydrologist-in-Charge (HIC) retains full authority for the operation of the WFO or RFC during the OAT. The MIC or HIC must approve all decisions affecting site operations during the OAT including: the schedule for installation of hardware, operation of the AWIPS communication networks, and site staff assignments.

### 4.1 Resource Requirements

**Hardware:** A GFP OCIO-Router capable of multi Virtual Routing and Forwarding (VRF) will be configured at each pilot site by the network service provider (Sprint). A FMK containing the Juniper SSG 550 CE router, NetScout T1 Probe, NetScout T1 Tap Kit, and all required cables and associated hardware will be provided to the sites. The FR Permanent Virtual Circuits (PVC) will remain in hot standby mode.

**Software:** Routers will be remotely configured from NCF to define the MPLS WAN as the primary path for AWIPS network communications. The network will be configured to allow remote selection of the existing FR WAN. ADTRAN will remain in place as the normal backup system.

**Documentation:** Documentation supporting the installation and operation of the MPLS WAN will be shipped to OAT sites prior to the commencement of field tests. Reference to these documents may be made as required throughout the test. Supporting documentation for the OAT includes:

- (Draft) Mod Note for MPLS WAN hardware installation (OPS12)
- (Draft) Mod Note for MPLS WAN cabling installation (OPS12)
- OAT Plan (OPS24)

The organizational unit responsible for preparation of each document is shown in parentheses.

The OAT Plan will also be available in electronic form on the OPS24 web site at:  
[http://www.weather.gov/ops2/ops24/documents/awips\\_docs.htm](http://www.weather.gov/ops2/ops24/documents/awips_docs.htm).

## 4.2 Pre-OAT Activities

### 4.2.1 National Weather Service Headquarters

WSH staff will complete the following actions prior to field tests:

- Prepare and distribute the OAT Plan (OPS24)
- Prepare and distribute the Mod Notes (OPS12)
- Coordinate with Sprint to ensure that the Provider Edge (PE) router and any other required network equipment is installed (OST31)
- Deliver the hardware together with all supporting documentation to the OAT sites (OST31)
- Monitor network communications using PAMS and provide daily network communications performance reports to Raytheon beginning on or before July 5, 2006 (OPS24)

The organizational unit responsible for completion of each item is shown in parentheses.

### 4.2.2 OAT Sites

OAT site staff will complete the following actions prior to commencement of field tests:

- Site Focal Points will assist Raytheon in determining the required types and lengths of cable.

### 4.2.3 NCF

NCF staff will complete the following actions prior to commencement of field tests:

- NCF staff will modify the network control software to define the MPLS WAN as the primary path for AWIPS network communications and to allow remote selection of the existing FR WAN, ADTRAN, or the MPLS WAN at each WFO site.

## 4.3 Test Readiness Review

The TRG Chair will convene a Test Readiness Review on or about August 15, 2006, 0930 EDT. The Test Readiness Review is held to verify that the prerequisites for field tests of the MPLS WAN have been met, see Section 1.6.1 for a list of prerequisites. The TRG will review the materials presented and recommend whether to proceed with tests of the MPLS WAN at operational field sites.

## 4.4 Installation

The dates scheduled for installation of the MPLS hardware are shown in Table 3. The MIC, HIC, Central Region Focal Point, or Site Focal Point will notify the OAT Director at the earliest opportunity, if operational concerns require departure from the dates shown.



#### 4.4.1 National Weather Service Headquarters

The OAT Director will visit the North Central RFC, Chanhassen, MN (MSR) and the WFO Grand Forks, ND (FGF) to observe the installation of MPLS WAN hardware and cabling and to review the Mod Notes with the Site Focal Points. The OAT Director will meet with the OAT site personnel upon arrival at the site to discuss the OAT Plan, see Attachment C. The OAT Director will revise the Mod Notes as required prior to installation of the MPLS WAN at the remaining OAT sites.

OCIO will test each MPLS circuit for a period of approximately 72 hours to ensure that the lines are clean.

#### 4.4.2 OAT Sites

OAT site personnel are responsible for the installation and execution of the FMK and for supporting hardware and cable changes. The OAT site personnel will evaluate the draft Mod Notes for installation of the hardware and cabling and forward any comments to the OAT Director.

### 4.5 Operations

The transition of AWIPS communications to the MPLS WAN will be completed in two phases: an initial startup period lasting approximately two weeks followed by 30 days of operations using the MPLS WAN. The MPLS WAN will be the preferred path for AWIPS network communications throughout the 30 day evaluation period. The two week startup period will begin on or about August 21, 2006 and the 30 day evaluation period will begin on or about September 4, 2006.

AWIPS NCF SOP will be followed whenever possible both during the startup period and the 30 day evaluation period: ADTRAN will be the normal backup system and AWIPS network communications will be immediately shifted to ADTRAN in the event of a network outage. The site Lead Forecaster will be immediately contacted in the event of a network outage; and if conditions warrant she or he may request that the site be paced on the FR WAN until MPLS services are restored.

The site MIC, HIC, or Lead Forecaster may contact the NCF at anytime during the OAT and request that the FR WAN be restored due to mission performance impact.

OPS24 personnel will monitor network communications using PAMS throughout and provide daily performance reports with hourly average product transmission statistics to Raytheon. OCIO will monitor the network performance using the NetScout probes. The RTMS will also be used to monitor network performance throughout the OAT.

#### 4.5.1 Network Startup

A period of approximately two weeks is allowed for the startup of MPLS network services. Raytheon will coordinate the systematic startup of the MPLS WAN with the sites, NCF, and OCIO during this period. The AWIPS NCF SOP will be followed whenever possible during startup.

Tests will be conducted during the startup to ensure that all network configuration controls are fully functional. NCF will conduct the following tests for each site:

- Switch network communication services from the FR WAN to the MPLS WAN
- Switch network communication services from the MPLS WAN to the FR WAN

- Switch network communication services from the MPLS WAN to the ADTRAN
- Switch network communication services from the ADTRAN to the MPLS WAN
- Test induced MPLS outages to ensure NCF ability to detect outages

The above tests may be coordinated with the normally scheduled monthly tests of the backup ADTRAN system when appropriate.

All tests must be coordinated with the affected sites and are to be witnessed by OPS24 personnel.

#### 4.5.2 Evaluation Period

The MPLS WAN will be the preferred path for AWIPS network communications throughout the 30 day evaluation period.

The MPLS WAN will be the sole link between the WFOs and RFCs and between the RFCs and NCF during the 30 day evaluation period: The existing FR circuits will be disabled. The FR will remain in hot standby and network traffic through the FR circuits may be restored at anytime; however, NCF action is required to enable the FR circuits in the event of an outage.

#### 4.5.3 AWIPS/MPLS Restoration and Coordination Process

A network outage may be detected by system alarm, NOAA Net contacting the NCF, or field offices contacting the NCF. The MPLS network is monitored by the network service provider, Sprint, and Sprint will notify the NCF in the event of a network outage.

#### WFO Network Outage Contingency Plan:

1. Upon detection of an MPLS outage, follow AWIPS NCF SOP.
  - i. Immediately switch network communications to ADTRAN.
  - ii. NCF contacts Lead Forecaster at affected site(s) to determine operational risk.
  - iii. If Lead Forecaster requests, NCF switches site to FR to reduce risk to operations.
2. NCF notifies OCIO and the AWIPS POC of an outage.
3. NCF advise site(s) whether restoration is imminent. If restoration of services is not imminent, prepare to switch to FR.

The contingency plan to be followed in the event of an outage of the MPLS WAN at a Pilot WFO is shown schematically in Figure 3.

#### RFC Network Outage Contingency Plan:

1. In the event of an MPLS outage at a Pilot RFC site
  - i. Network traffic will be directed to the FR circuits.
  - ii. The NCF will monitor message queues during the outage.

2. In the event of an FR outage at a Pilot RFC site
  - i. Network traffic will remain on the MPLS WAN.
  - ii. The NCF will monitor message queues during the outage.
3. In the event of an FR outage at a non-MPLS RFC site
  - i. Network traffic will remain on the MPLS WAN at the Pilot RFC.
  - ii. The NCF will monitor message queues during the outage.
  - iii. Network traffic will be directed to the FR circuits as required.

## 4.6 Test Reporting and Analysis

### 4.6.1 Trouble Reports

The OAT site staff will follow normal procedures and contact NCF staff regarding network problems as required during the OAT. The NCF will file a Trouble Ticket for each problem reported. The OAT Director will review the NCF Trouble Tickets and prepare OAT Test Trouble Reports (TTRs) as required.

OAT site staff may also submit TTRs directly to the OAT Director. The OAT Site Focal Point will coordinate the preparation and submission of TTRs with their respective staff members. The completed TTR form, Attachment A or the equivalent, together with any supporting documentation, should be submitted by email or fax message to the OAT Director at the address provided below, in Section 4.9.

### 4.6.2 TTR Analysis

The OAT Director will collect the TTRs, maintain a database to track the status of each TTR, and provide the TTRs to the TRG for adjudication, see Section 3.1. The database allows the assignment of an Impact and Priority to each TTR.

The Impact ranks the severity of the problem and will be assigned as follows:

- Impact 1 Severe degradation of communications; no workaround
- Impact 2 Severe degradation of communications; reasonable workaround
- Impact 3 Degradation of communications
- Impact 4 Loss of minor capability
- Impact 5 No impact

TTRs that are assigned Impact 1 mandate the immediate suspension of the OAT.

The Priority addresses how the problem is to be resolved and will be assigned as follows:

- Priority 1 Immediate action required
- Priority 2 Expedite action
- Priority 3 Normally scheduled action
- Priority 4 Watch item
- Priority 5 No action required

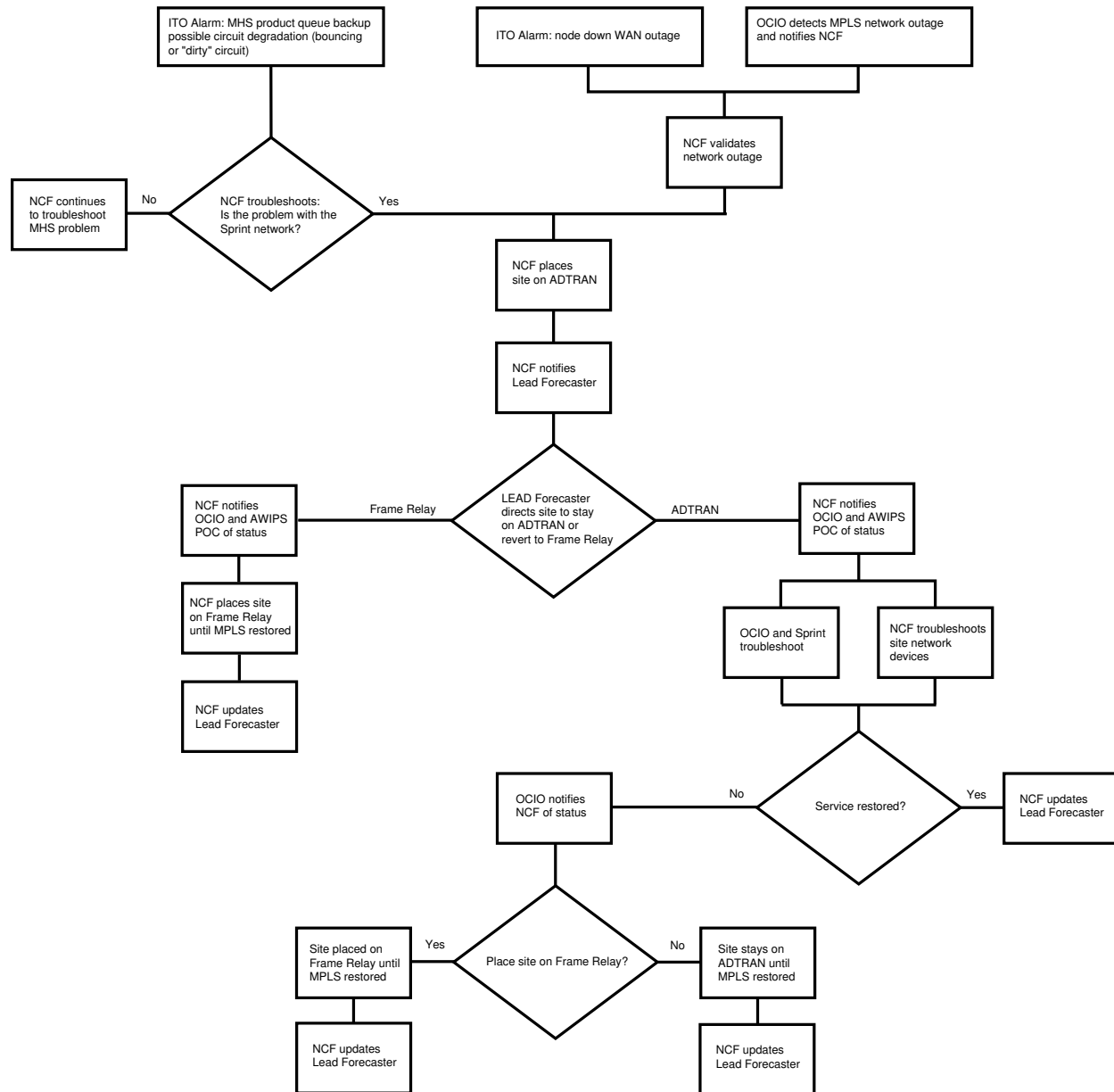


Figure 3: WFO network outage contingency plan.

## 4.7 Network Performance Reporting and Analysis

### 4.7.1 Quality of Service Analysis

The figures-of-merit monitored during the OAT will include the average message delay and the average message loss rate. Other factors such network outages and the reliability of network services will also be monitored.

**Service Level Agreement** The MPLS service provider has provided the Government specific commitments for the quality of network services, that is a Service Level Agreement (SLA). The SLA lists figures-of-merit and performance commitments for MPLS WAN services. The figures-of-merit relevant to the MPLS OAT include the Network Packet Loss, Network Round-trip Delay, and Network Jitter. The commitments for quality of service for these parameters are listed in Table 2. The levels indicated are monthly averages for packet level measurements.

Table 2: Sprint Service Level Agreement Commitments.

Network Packet Loss	Network Round-trip Delay	Network Jitter
0.1 %	< 55 ms	< 2 ms

### 4.7.2 Network Outages

The outages may be determined from NCF, OCIO, and/or Sprint trouble tickets. Anytime that MPLS is not available and ADTRAN or the FR WAN is used will count as MPLS outage for the Pilot. Delays transferring back to MPLS do not count toward the outage; Sprint Managed Network Services (MNS) tickets will capture the time stamp for restoration of the MPLS. NCF will capture the site restoration time (site switches back to MPLS) within their trouble ticket.

### 4.7.3 PAMS Data Analysis

It should be noted that the SLA is stated in terms of packet communications and that PAMS monitors communications at the message level. The SLA commitments cannot, therefore, be directly assessed using PAMS. However, the measured communications performance at the message level may infer the packet level performance.

PAMS only measures the end-to-end product availability and has no capacity to determine the path a particular product may have taken en route. PAMS cannot therefore distinguish between messages sent over the FR or MPLS WANs. The assignment of the path relies on a knowledge of the circuit. The configuration of the networks between the WFOs and RFCs and the RFCs and NCF may differ during the OAT:

Although the MPLS WAN will be defined as the preferred path, the transmission of products over the FR WAN is not strictly prohibited. If the MPLS WAN saturates, traffic may be transmitted over the FR link between the RFC and NCF. The network link between the RFCs and NCF will carry all network traffic to and from the normally assigned WFOs; traffic over the MPLS WAN will not be restricted to the WFO OAT sites. Network traffic between the RFCs and NCF may thus include an admixture of FR and MPLS messages and will include traffic from non-OAT WFO sites.

The network link between the WFOs and RFCs is more tractable: Barring an outage of the MPLS WAN, the path between the RFCs and the WFOs will be restricted to the MPLS WAN. The FR Permanent Virtual Circuit (PVC) will be turned off for the OAT WFOs. The non-OAT WFOs will continue to send and receive

messages over the FR WAN. *PAMS may provide an accurate count of the products transmitted between the WFOs and RFCs provided any MPLS outages are matched to the PAMS records.*

A meaningful interpretation of the PAMS data requires an accurate description of the network configuration. *The NCF must provide an accurate description of the active network circuits to properly interpret the PAMS data.* OPS24 will seek to coordinate with NCF to provide meaningful metrics of network performance.

## 4.8 Schedule

The OAT will be conducted in accordance with the schedule provided in Table 3. Any required departure from the indicated schedule should be brought to the immediate attention of the OAT Director. The OAT Director will notify the members of the TRG of any required schedule changes and coordinate the timely completion of the OAT.

Table 3: MPLS OAT Schedule

Date	Time (EDT)	Action
07/05/06		Begin AWIPS baseline data capture for the FR WAN (OPS24)
07/21/06	0930	Critical Design Review
07/21/06		Draft installation instructions (Raytheon)
07/25/06		Ship FMK to North Central RFC, Chanhassen, MN (MSR) and WFO Grand Forks, ND (FGF) (OST31)
08/01/06		Site visit and MPLS hardware installation North Central RFC, Chanhassen, MN (MSR)
08/03/06		Site visit and MPLS hardware installation WFO Grand Forks, ND (FGF)
08/08/06		MPLS hardware installation WFO Aberdeen, SD (ABR)
08/09/06		MPLS hardware installation Missouri Basin RFC, Pleasant Hill, MO (KRF)
08/15/06	0930	Test Readiness Review
08/21/06		MPLS installations completed
08/21/06		Switch AWIPS communications to MPLS WAN (NCF)
08/23/06	1300	TRG meeting
09/04/06		Begin data capture for the MPLS WAN (OPS24)
09/08/06	1300	TRG meeting
09/21/06	1300	Mid Pilot Review/TRG Meeting
10/06/06		End of field tests
10/11/06	1300	OAT Wrap Up meeting
10/11/06		Prepare OAT Report

## 4.9 Help During the OAT

Questions regarding the MPLS OAT should be directed to:

Ken Stricklett, MPLS OAT Director  
 phone: (301) 713-0326 x113  
 fax: (301) 713-0912  
 email: Ken.Stricklett@noaa.gov

Questions regarding the MPLS Pilot should be directed to:

Olga Brown-Leigh, MPLS AWIPS POC  
phone: (301) 713-1570 x156  
fax: (301) 713-9395  
email: olga.brown-leigh@noaa.gov

Questions regarding the NCF network communications should be directed to:

NCF Help Desk  
phone: (301) 713-9344

The NCF Help Desk is staffed 24×7.

## 4.10 Post-OAT Activities

### 4.10.1 OAT Questionnaire

Site Focal Points should complete the MPLS OAT Questionnaire, Attachment B, upon the conclusion of field tests. The responses should be coordinated with the test site management and staff. The completed form together with any additional comments should be submitted to OAT Director by not later than October 6, 2006.

### 4.10.2 Final Recommendation

The TRG Chair will convene an OAT Wrap Up meeting on or about October 11, 2006 following the conclusion of field tests. This is the final meeting of the TRG. The OAT Director will review the activities conducted to date including: a summary of TTRs found, a summary of the network performance data, other findings, and recommendations. The TRG will review the materials presented and recommend whether to proceed with national deployment of the MPLS WAN. The MPLS AWIPS POC will report the recommendation of the TRG to the OST System Engineering Center (SEC). The SEC will make all final decisions regarding migration of AWIPS network communications to the MPLS WAN.

The MPLS WAN must meet the following criteria to be recommended for national deployment:

- All TTRs assigned Impact 1 or 2 must be resolved and closed.
- All problems resolved by a workaround must be properly documented.
- All measures of network communications performance for the MPLS WAN must equal or exceed those obtained for the existing FR WAN.
- All measures of network communications performance for the MPLS WAN must be consistent with the Sprint Service Level Agreement.

### 4.10.3 OAT Report

The OAT Report provides a complete record of the OAT including: details of any TTRs, findings, and recommendations. The OAT Report will be prepared following the completion of field tests and will be posted on the OPS24 website at: [http://www.weather.gov/ops2/ops24/documents/awips\\_docs.htm](http://www.weather.gov/ops2/ops24/documents/awips_docs.htm).

## Attachment A MPLS Test Trouble Report Form

Site Focal Points should complete this form for each problem discovered during the OAT. The completed form together with any supporting documentation should be submitted to Ken Stricklett, MPLS OAT Director (FAX: 301-713-0912 or Email: Ken.Stricklett@noaa.gov).

<b>MPLS OAT TEST TROUBLE REPORT (TTR)</b>
<b>TTR No.:</b>
<b>Title/Summary:</b>
<b>Originator:</b>
<b>Location:</b>
<b>Date/Time Discovered:</b>
<b>Attachments:</b>

Subsystem		Frequency		Impact		Priority	
Installation		Always		Severe degradation of communications; no workaround		Immediate action required	
Documentation		Sometimes		Severe degradation of communications; reasonable workaround		Expedite action	
Software		Rarely		Degradation of communications		Normally scheduled action	
Hardware		One-time event		Loss of minor capability		Watch item	
		Unknown		Minimal to no impact		No action required	

<b>Reference ECRs/TTRs:</b>		
<b>Problem Description:</b>		
<b>Recommended Solution:</b>		
<table border="1"> <tr> <td><b>Authorizing Signature:</b></td> <td><b>Date:</b></td> </tr> </table>	<b>Authorizing Signature:</b>	<b>Date:</b>
<b>Authorizing Signature:</b>	<b>Date:</b>	



## Attachment B MPLS OAT Questionnaire

Site Focal Points should complete this form upon the completion of field tests. The responses should be coordinated with the test site management and staff. The completed form together with any additional comments should be submitted to Ken Stricklett, MPLS OAT Director (FAX: 301-713-0912 or Email: Ken.Stricklett@noaa.gov) by not later than **October 6, 2006**.

Test Site: \_\_\_\_\_ Date: \_\_\_\_\_

Name and Title: \_\_\_\_\_

Beginning and Ending Dates of Test: \_\_\_\_\_

Select the rating box for each statement that best describes your experience.

- |     |                |   |
|-----|----------------|---|
| 5   | Excellent      | Performed in a manner that could not be improved.   |
| 4   | Good           | Performed well, met field needs and offered some improvements.                                |
| 3   | Satisfactory   | Performed in a manner that meets basic field needs.   |
| 2   | Deficient      | Performed in unsatisfactory manner, does not fully meet field needs, may be workarounds.      |
| 1   | Unsatisfactory | Unacceptable performance, does not meet field needs, and negatively impacts field operations. |
| N/A |                | Does not apply.   |

Statement	1	2	3	4	5	N/A
The AWIPS System Modification Notes (Mod Notes) were accurate and complete.						
The Field Modification Kit (FMK) was complete.						
NCF responded in a timely manner to help requests.						
NCF responses fully satisfied the issue raised.						
AWIPS network communications were fully supported by the MPLS WAN.						
The MPLS OAT fully satisfied the need for quality assurance.						
The MPLS OAT was administered in a professional manner.						

Please comment on any item that was rated 1, 2, or 3. You may provide other comments, as desired.

## Attachment C   Agenda for OAT Site Visit

1. Introductions	Test Coordinator
2. The Test Structure	Test Coordinator
<ul style="list-style-type: none"><li>• Overview of the MPLS Pilot</li><li>• Test schedule</li></ul>	
3. Test Team Responsibilities	Test Coordinator
<ul style="list-style-type: none"><li>• Hours working on-site</li><li>• Activities</li></ul>	
4. Site Management and Staff Responsibilities	Test Coordinator
<ul style="list-style-type: none"><li>• Site Focal Point Responsibilities</li><li>• Reporting/documenting problems</li></ul>	
5. Test Team Office Needs	Test Coordinator
<ul style="list-style-type: none"><li>• PC with Internet connection, copying, phones, work space, etc.</li></ul>	
6. Discussion	Site Management

## Attachment D MPLS Test Review Group Members

Name/Organization	Role	Phone	Voting Member
<b>Weather Service Headquarters</b>			
Jerald Dinges (W/OPS24)	Test Review Group Chair	(301) 713-0326 x160	•
Olga Brown-Leigh (W/OST31)	MPLS AWIPS POC	(301) 713-1570 x156	•
Phil Cragg (W/CIO14)	OCIO Focal Point	(301) 713-0984 x216	•
Ken Stricklett (W/OPS24)	OAT Director	(301) 713-0326 x113	
Mary Buckingham (W/OPS24)	Test Team Member	(301) 713-0326 x137	
Khien Nguyen (W/OPS24)	Test Team Member	(301) 713-0326 x177	
Jami Casamento (W/CIO14)	Test Team Member	(301) 713-0499 x211	
Randy Chambers (W/CIO11)	Test Team Member	(301) 713-0864 x161	
Jagdish Sharma (W/OPS12)	Test Team Member	(301) 713-1833 x128	
Jim Stamper (W/CIO11)	MPLS NCF POC	(301) 713-9362 x322	
Kim Hoang (W/CIO11)	MPLS NCF POC	(301) 713-9344	
<b>Central Region</b>			
Central Region HQ, Kansas City, MO (BCQ) William Gery (W/CR41)	Regional Focal Point	(816) 268-3152	•
WFO Aberdeen, SD (ABR) Brian Ambuehl James Scarlett	Site Focal Point MIC	(605) 225-0519 x381 (605) 225-0519	
WFO Grand Forks, ND (FGF) Michael Lukasz Dave McShane	Site Focal Point MIC	(701) 795-5198 x372 (701) 795-5198 x642	
Missouri Basin RFC, Pleasant Hill, MO (KRF) John Tatum Mike Hudson	Site Focal Point MIC (Acting)	(816) 540-5147 x372 (816) 540-5147 x726	
North Central RFC, Chanhassen, MN (MSR) Bruce Aslesen Dan Luna	Site Focal Point HIC	(952) 361-6670 x372 (952) 361-6650	
<b>Southern Region</b>			
Eric Howieson	Regional Focal Point	(817) 978-7777 x132	•
<b>Eastern Region</b>			
Joe Palko	Regional Focal Point	(412) 262-2582 x235	•
<b>Western Region</b>			
Gar Nelson	Regional Focal Point	(801) 524-5120	•
<b>Pacific Region</b>			
Bill Ward	Regional Focal Point	(808) 532-6415	•
<b>Alaska Region</b>			
Phil Mieczynski	Regional Focal Point	(907) 271-4421	•